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RELIABILITY OF POINT OF CARE GLUCOSE TESTING COMPARED TO LABORATORY GLUCOSE ANALYSER

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Abstract

Accurate measurement of blood glucose is essential for the diagnosis, monitoring, and management of diabetes mellitus and other metabolic disorders. While laboratory-based glucose analyzers are considered the gold standard due to their high accuracy and quality control, point-of-care testing (POCT) glucose meters are widely used because of their rapid turnaround time and ease of use. However, concerns remain regarding the reliability and accuracy of POCT results compared to laboratory measurements, particularly in clinical settings. This cross-sectional comparative study aims to evaluate the reliability and agreement between point-of-care glucose testing and standard laboratory glucose analysis. The study was conducted in the clinical laboratory and outpatient department of a tertiary care hospital over a period of six months. A total of 100–150 patients undergoing routine blood glucose testing were included using a convenience sampling technique. For each participant, simultaneous capillary blood samples were analysed by a POCT glucometer and venous blood samples were analysed by an automated laboratory analyser. The precise monitoring of glucose is therefore essential given the severe clinical implications of sustained high glucose levels. Persistently high blood glucose levels are a known risk factor for diabetic neuropathy, nephropathy, retinopathy, cardiovascular disease and cerebrovascular accidents. Data were statistically analysed using paired t-test, Pearson's correlation coefficient, and Bland–Altman analysis to determine correlation, agreement, and bias between the two methods. The results of this study will help to establish whether POCT glucose meters deliver sufficiently accurate results for clinical decision making or whether confirmatory laboratory testing is required, thus improving patient safety and evidence-based practice.

CHAPTER 1
INTRODUCTION

Blood glucose levels play a direct role in clinical decision making, including the initiation of therapy, adjustment of insulin or oral hypoglycemic medications, and assessment of treatment efficacy. Errors in measuring glucose can lead to inappropriate treatment measures that may cause acute complications such as hypoglycemia or hyperglycemia, as well as long-

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term consequences such as microvascular and macrovascular damage. (1).

Diabetes mellitus is one of the most important global public health problems of the modern era. The International Diabetes Federation (IDF) recently estimated that the number of people with diabetes worldwide was 537 million in 2023 and is expected to rise to 643 million in 2030 and 783 million in 2045 (2). The disease is becoming more common in cities and among people who live sedentary lives, change their diets and age are all more likely to get it. It is happening more in countries with fewer resources (3). A substantial percentage of people with diabetes are undiagnosed, increasing the risk of consequences from delayed diagnosis and treatment .

The International Diabetes Federation (IDF) estimates that 537 million people worldwide had diabetes in 2023. This number is growing fast due to various social and life style changes. IDF estimates that in the absence of effective preventive measures, the number of diabetes patients could increase to 643 million in 2030 and to 783 million in 2045.

There are a number of reasons contributing to the rise of diabetes worldwide. One big factor is urbanisation. This often leads to less physical activity and unhealthy lifestyle habits. People living in cities are generally used to sedentary routines, sitting for long periods of time and doing less physical exercise. Additionally, the increased availability of processed foods, sugary drinks, and high-calorie diets has significantly raised the risk of developing type 2 diabetes.

Another big factor is the ageing population. With an increasing life expectancy globally, more people are living to an age where the risk of diabetes is higher. Furthermore, the largest increases in diabetes cases are happening in low- and middle-income countries. This means they are diagnosed and treated late and are at risk of serious complications, such as heart disease, kidney failure, blindness and nerve damage. Reducing the global burden of diabetes requires early diagnosis and periodic screening, public awareness and healthier lifestyles (4).

Diabetic neuropathy, nephropathy, retinopathy, cardiovascular disease, and cerebrovascular accidents are known to be risk factors in persistent hyperglycemia (5). Hypoglycemia, in turn, can cause sudden neurological impairment, convulsions, coma and even death (6), often as a result of improper insulin dosage. Thus, accurate glucose testing is important in many therapeutic settings such as emergency rooms, intensive care units and outpatient diabetes clinics.

Laboratory-Based Blood Glucose Measurement:

These analyzers usually use enzymatic techniques such the hexokinase, glucose oxidase, or glucose dehydrogenase tests, all of which have shown excellent analytical precision and accuracy when carried out in controlled laboratory settings (7). Because plasma glucose content is about 10–15% greater than whole blood glucose and yields more consistent results, venous plasma is the recommended material for laboratory analysis (8). Standardized calibration processes, stringent internal and external quality control systems, and the use of laboratory analyzers by qualified personnel are all advantageous. Their improved analytical performance and repeatability are a result of these factors (9). These factors lead to the use of laboratory glucose measurements as reference values in diagnostic criteria, clinical research, and performance assessments of alternative testing techniques (10).

Laboratory-based testing has significant drawbacks despite its benefits. (11).

Point-of-Care Testing (POCT) for Blood Glucose:

Point-of-care testing (POCT) is diagnostic testing done at or near the site of patient care, with the aim of providing rapid data that can inform therapeutic decisions in a timely manner. Glucometers or portable blood glucose meters are the most widely used POCT modalities worldwide (12). They are generally encountered in hospitals, outpatients' clinics, emergency rooms and intensive care units and are used for self-monitoring of blood glucose (SMBG) in diabetic patients.

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POCT glucose meters offer a lot of advantages over laboratory testing. They are easy to use, portable, not too expensive, require small amounts of capillary blood and give results in seconds (13). Due to these characteristics, glucometers are crucial in circumstances where swift glucose testing is necessary, such as in insulin titration,

Increased patient involvement in diabetes self-management has contributed to the increased reliance on POCT devices. SMBG is important for achieving glycaemic control, reducing the risk of complications, and improving quality of life in people with diabetes (15). Therefore, the accuracy and reliability of glucometers are essential for patients who use them to make treatment decisions on a daily basis and for medical professionals.

Concerns Regarding Accuracy and Reliability of POCT Devices:

Although POCT glucose meters are widely used, their accuracy, precision and reliability in comparison with laboratory analysers are still questionable. Precision is the repeatability of results under the same conditions, while accuracy is the proximity of a measurement to the true value (16). POCT results can be affected by various preanalytical, analytical and postanalytical conditions.

Glucometer accuracy is greatly impacted by physiological factors such hematocrit fluctuation. Low haematocrit levels may overestimate glucose levels and high haematocrit levels may underestimate glucose levels (17). This is especially important as abnormalities in haematocrit are common in neonates, pregnant women and critically ill patients (18). Capillary glucose readings are also subject to influence from oxygen tension, dehydration, peripheral perfusion status and acid-base abnormalities (19)

Operational and technical factors also contribute to measurement variability. These include incorrect sample application, inadequate storage of strips, expired test strips, humidity and temperature in the environment, calibration problems and operator related problems (20). Some of the glucometer systems were found to have analytical interference due to some intravenous fluids, ascorbic acid, uric acid, acetaminophen and other interfering chemicals (21).

POCT Accuracy in Critically Ill Patients:

The reliability of point-of-care testing (POCT) for glucose in critically ill patients remains a matter of debate. Patients in intensive care units often present haemodynamic instability, anaemia, hypoxia, and altered microcirculation that can potentially affect the accuracy of capillary glucose measurements (22). Several studies have shown clinically relevant differences between POCT and have expressed concerns about wrong insulin doses and increased risk of hypoglycemia (23). To address these problems, the International Organization for Standardisation (ISO) has developed performance criteria for blood glucose monitoring systems.

Glucose measurement is commonly performed in hospitals using point-of-care testing (POCT), particularly in intensive care units (ICU), as it provides quick results helping healthcare professionals to make timely treatment decisions.

The accuracy of glucose measurements may be affected by complex medical conditions in intensive care units. Capillary blood sampling is frequently used in bedside glucometers and may be affected by factors such as haemodynamic instability, anaemia, hypoxia and altered microcirculation. Physiological changes Several clinical studies have shown considerable differences between glucose levels obtained using POCT devices and conventional laboratory methods. Such differences can be fatal, since medical personnel rely on these readings to calculate insulin dosage. Incorrect glucometer readings may result in inappropriate insulin administration, which could cause hypoglycemia (dangerously low blood sugar) or uncontrolled hyperglycemia in critically ill patients.

To address such concerns and to assure quality of blood glucose monitoring systems, the International Organization for Standardisation (ISO) has developed performance guidelines. ISO 15197:2023 states that for glucose levels below 100 mg/dL, at least 95% of the POCT device's

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glucose readings must be within ±15 mg/dL of the laboratory reference value. For glucose concentrations equal to or > 100 mg/dL, the result must be within ±15% of laboratory value. The purpose of these standards is to ensure that glucometers are producing results that are reliable and clinically acceptable.

Many modern glucometers are designed to meet these ISO performance standards when tested in the laboratory or under controlled conditions, but their accuracy may vary in real-life clinical settings.(25)

Evidence from Recent Comparative Studies:

In recent 5 to 7 years, many comparative studies have been performed to evaluate the analytical performance of POCT glucose meters with respect to laboratory analysers. Correlation, although shown to be good between the two techniques in many studies, does not imply agreement or clinical interchangeability (26). Several studies have shown systematic bias by Bland–Altman analyses in which POCT devices either overestimate or underestimate glucose values at extreme concentrations (27).

Recent systematic reviews and meta-analyses have shown that professional glucometers are generally better than home glucometers, but there is still heterogeneity among brands and clinical settings (28). Some studies suggest that POCT devices may be useful in tracking glucose trends, but may not be reliable enough for critical treatment decisions or diagnostic purposes without laboratory confirmation (29).

Clinical Implications and Rationale for the Study:

Inaccurate glucose values can lead to significant clinical implications. Overestimation of glucose levels can lead to excessive insulin administration, increasing the risk of hypoglycemia (30), whereas underestimation of glucose levels may delay the treatment of hyperglycemia and contribute to poor glycaemic control. Such errors can lead to worse outcomes, longer hospital stays, and increased Because these devices are common and their performance is variable , it is important to continually evaluate the reliability of POCT glucose meters in particular clinical settings. Local validation studies are particularly important as the performance of a device may be affected by patient demographics, operator training and ambient factors (31).

Aim of the Study:

In the present study we compare the accuracy of laboratory-based and point-of-care glucose testing in a clinical population. This study aims to evaluate if POCT devices can serve as a valid alternative to laboratory glucose measurements or if confirmatory laboratory testing is needed for correct diagnosis and critical clinical decision making by assessing correlation, precision, bias, and agreement between POCT glucose The present study aimed to assess the accuracy and reliability of point of care testing (POCT) glucose devices compared to laboratory-based glucose analysis in a clinical population.

In general, laboratory glucose analysers are the gold standard because they employ sophisticated analytical methods that yield very accurate and reproducible results. However, POCT devices are increasingly used in hospitals, clinics and emergency settings as they are capable of providing rapid results at the patient's bedside. POCT is widely used and convenient, but there are still concerns about its accuracy under different clinical conditions, so a systematic comparison between POCT and The study aims to determine if POCT devices can reliably substitute for traditional laboratory glucose testing or if laboratory confirmation is still needed for accurate diagnosis and treatment decisions. In many health care settings, particularly in intensive care and emergency departments, the need for rapid decision making is essential to the management of patients with variable glucose level

But if there are large discrepancies between POCT and lab measurements, reliance solely on bedside glucometers may result in inappropriate clinical decisions.

To achieve its goal, the study evaluates a number of key statistical parameters like correlation, precision, bias and agreement between two

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testing methods. Correlation analysis can be used to assess the degree to which POCT device results track the pattern of laboratory analyser measurements. Precision is the degree to which replicate measurements under unchanged conditions give the same results. Bias analysis measures the systematic difference between POCT values and laboratory results and helps determine whether the bedside device tends to over- or underestimate glucose concentrations. Also, agreement analysis provides a detailed assessment of the closeness of the two measurement methods over a wide range of glucose concentrations in clinical samples.

However, faced with substantial differences, health care providers may have to rely on laboratory confirmation before making critical treatment decisions. Therefore, this study contributes to improving patient safety, increasing diagnostic accuracy, and assisting healthcare professionals in choosing the most appropriate approach for measuring blood glucose levels in clinical practice.

RATIONALE OF THE STUDY:

In clinical practice, point-of-care glucose testing is commonly used because of its short turnaround time and ability to facilitate immediate clinical decision-making. However, its accuracy compared with laboratory glucose analysers, the gold standard, is a concern (22). Factors such as variation in haematocrit and type of sample might affect the reliability of POCT, which may result in incorrect diagnosis or treatment decisions (23).

Many healthcare settings, particularly resource-limited settings, rely on POCT devices without routine validation against laboratory standards. The correlation of POCT glucose measurements with laboratory glucose values and their safe use in clinical practice need to be evaluated. The aim of this study is to evaluate the reliability and agreement of POCT and laboratory glucose testing for patient safety and for evidence-based clinical practice.

These handheld glucometers give quick results and make it easy for healthcare professionals to monitor patients at bedside or outpatient clinics. Such devices are heavily relied upon by clinicians to make immediate clinical decisions, because laboratory facilities are not always readily available. POCT devices are valuable tools in patient care because of their speed and convenience. The main problem in such settings is that POCT devices are frequently used without regular validation against standard laboratory glucose measurement systems. Laboratory analysers tend to employ more sophisticated and controlled analytical methods, which generate highly accurate and standardised results. POCT devices can be influenced by factors such as environmental conditions, device calibration, sample collection methods and operator handling. The accuracy of glucose measurement is crucial for patient safety.

The exact measurement of the blood glucose is very important because it is vital in the diagnosis and management of diabetes and other metabolic disorders. Inaccurate glucose readings can lead to incorrect clinical decisions such as wrong insulin administration or delayed treatment. For example, if a POCT device reports a lower glucose level than is actually present a patient may not be treated properly for hyperglycemia. Conversely, if the device overestimates glucose levels, too much insulin may be administered leading to dangerous hypoglycemia.

In resource-limited healthcare settings, the limited availability of laboratory infrastructure and lack of trained manpower further increases dependence on POCT devices. In these areas, hospitals and clinics often lack sophisticated diagnostic equipment, so bedside testing is often the most practical option for monitoring patients.

Another important point to consider is the relationship of POCT glucose values to laboratory glucose values. Correlation analysis is useful in determining if the values obtained by POCT devices follow a similar pattern as those obtained by laboratory analysers. A strong correlation would show that the two methods consistently give the same results at different glucose levels indicating that the POCT devices may be suitable for routine clinical use. Alternatively, poor correlation would raise

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questions about their reliability and highlight the need for confirmatory laboratory testing. Agreement analysis is a way to determine how close the numbers from POCT devices are to those from lab analysers. A high correlation between two methods does not imply that the individual measurements are similar. Thus, studies of agreement provide a more detailed insight POCT

Precision is another important factor that must be taken into account when assessing the reliability of POCT devices. Precision is the ability of an instrument to give the same result when the same sample is analysed repeatedly . A good POCT device should give comparable results on repeated measurements and should not vary widely. Poor accuracy may lead to inconsistent glucose readings that can confuse clinicians and affect patient management decisions.

Bias also needs to be taken into account when comparing POCT and laboratory glucose measurements. Bias is the systematic difference between the two methods of testing. It is a measure of whether the POCT devices systematically give higher or lower readings than the laboratory analysers. Bias detection is important, since even a slight, but persistent, difference can have important clinical implications.

The main aim of this study is to provide a comprehensive evaluation of the reliability of POCT glucose testing as compared to laboratory based glucose analysis. The research is aimed at assessing parameters like correlation to see whether POCT devices can provide results accurate enough for clinical decision making. The results of paired glucose measurements from the same patients using the two methods will be statistically analysed in the study.These results will help to determine whether clinicians can safely rely on POCT devices for glucose monitoring or whether laboratory confirmation will remain a necessary step for accurate diagnosis and treatment planning. It is essential that the results of POCT are very comparable to laboratory values in order to maintain patient safety The results will also contribute to the promotion of evidence based clinical practice

OBJECTIVES OF THE STUDY

Primary Objective

To evaluate the reliability and accuracy of point of care glucose testing compared to the gold standard laboratory glucose analyser.

Secondary Objectives

1. To assess the correlation between POCT glucose values and laboratory plasma glucose values.
2. To assess the level of concordance and bias of the 2 methods using standard statistical tools.
3. To verify if POCT glucose values meet acceptable international performance standards.

HYPOTHESIS

Null Hypothesis (H_0):

Point-of-care testing glucose results correlate well with laboratory glucose analysers and are not significantly different from them.

Alternative Hypothesis (H_1):

Point-of-care testing of glucose levels is significantly different from laboratory glucose analysers.

CHAPTER 2
LITERATURE REVIEW

Dean, A. S., et al. (2022). Global burden of human brucellosis: a cross-sectional study. The study used data from several countries to estimate that more than 500,000 new cases of brucellosis occur worldwide each year. The highest incidence rates were reported in the Middle East, the Mediterranean areas, sub-Saharan Africa and parts of Asia. The study identified several significant risk factors, including close contact with livestock, consumption of unpasteurised dairy products, and occupational exposure. The authors underlined that brucellosis is a significantly underreported zoonotic disease, due to problems in diagnosis and absence of surveillance systems in endemic areas.

Mantur, B. G., et al. in 2022, in Karnataka, India, conducted a hospital-based cross-sectional

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study to ascertain the clinical profile. Among 400 patients tested, seropositivity by standard agglutination test (SAT) was 9.75%. The most frequent clinical manifestations were fever (100%), arthralgia (65%), and hepatosplenomegaly (38%). Seropositivity was significantly associated with occupational exposure to animals and consumption of raw milk. The study concluded that brucellosis should be routinely considered in cases of pyrexia of unknown origin in endemic areas. In Pakistan, a retrospective study of Khan, M. Z. et al. in 2021 assessed the prevalence of brucellosis among suspected cases at tertiary care hospitals. A total of 1200 serum samples were tested using RBPT and ELISA, with an overall seroprevalence of 11.3%.

Higher prevalence was observed among males and with involvement in livestock farming. The study found significant association of brucellosis with consumption of unboiled milk. The authors stressed the need for public health education and better diagnostic facilities in the rural areas. Dadar M et al. Investigation of brucellosis in high risk occupational groups; a cross-sectional sero-epidemiological study in Iran. Among 540 participants and abattoir workers the overall seroprevalence was 17.6%. The highest seropositivity was found among veterinarians (24.3%). Occupational exposure was identified as a major source of human brucellosis transmission (24). Bouley, A. J., et al. . 2020. "Prevalence of brucellosis at the human–livestock interface: A descriptive cross-sectional study in northern Tanzania."

Of 387 febrile patients tested, 7.7% were confirmed positive by serology and culture methods. Infection rates were higher among those living in pastoral communities than among those living in urban areas. The study highlighted the need for close human–animal interaction and the need for integrated One Health approaches for effective brucellosis control (25).

Accurate measurement of blood glucose is important for the diagnosis, monitoring and treatment of diabetes mellitus and for maintaining glycaemic control in hospitalised patients. The central laboratory glucose analysers using plasma samples and enzymatic reference methods such as the hexokinase method are the traditional gold standard for measurement of glucose. However, point-of-care testing (POCT) devices, commonly known as glucometers, are widely used because of their rapid turn-around time, ease of use, portability, and capacity to offer prompt clinical decision support.

Therefore, the reliability of POCT has been extensively studied compared to laboratory glucose analysers in a variety of clinical settings.

Several studies have assessed the correlation between POCT devices and laboratory analysers. Andriankaja et al. (2021) demonstrated that the point-of-care glucose measurements strongly and positively correlate with the central laboratory values, suggesting that POCT can be used for routine monitoring of hospitalised patients with clinically acceptable results (26). The authors observed that while the correlation coefficients were strong, there was a systematic bias with POCT devices, which sometimes overestimated the glucose values relative to laboratory measurements. Khan et al. (2025) looked at the variability between bedside glucose meters and central laboratory analysers and found significant differences in certain clinical situations (27). The majority of readings were within acceptable analytical limits; the discrepancies were more pronounced in critically ill patients.

Denfeld et al. (2022) compared the accuracy and precision of POCT in cardiothoracic surgery patients and found that point-of-care glucose values were significantly higher than laboratory plasma glucose (28). Crucially, they found that haematocrit was an important factor. Overestimation of glucose readings from POCT devices was associated with low haematocrit levels. This finding is an illustration of how patient-specific biological variables can impact glucometer performance.

Alshaer et al. (2022) compared capillary, venous and arterial glucose measurements from POCT devices with central laboratory results in critically ill patients with and without shock (29). Capillary samples showed less agreement with laboratory analysers than venous samples, the researchers reported. Capillary glucose accuracy in shock

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patients was greatly affected by changes in peripheral perfusion.

In a large evaluation of patients in intensive care units, the mean difference between POCT and laboratory values was relatively small, but clinically significant differences were observed at extreme glucose levels (30). The authors concluded that POCT is acceptable for routine monitoring but that laboratory confirmation should be performed when accurate determination of glucose is required, particularly in hypoglycemic or hyperglycaemic emergencies.

The performance of the glucometers has also been assessed according to international standards. Studies evaluating compliance with ISO 15197 guidelines report that many modern POCT devices achieve minimum accuracy requirements in controlled settings (31). However, in the real-world hospital setting, pre-analytical and analytical errors can impair reliability. Accuracy was significantly affected by quality control practices and staff training.

In a study comparing different enzymatic methodologies, laboratory analysers employing the hexokinase method showed better specificity and lower analytical variability than electrochemical strip-based POCT devices (32). The hexokinase method is less sensitive to oxygen levels, drugs and metabolic by-products and is therefore more reliable in critically ill patients.

In paediatric populations, studies comparing glucometer readings with laboratory glucose oxidase methods showed strong correlation but noted systematic bias, particularly at low glucose concentrations (33). In children, accurate detection of hypoglycemia is important and therefore laboratory confirmation in borderline cases was recommended.

Another study assessing POCT during oral glucose tolerance testing (OGTT) showed high sensitivity and specificity in comparison to laboratory plasma glucose measurement (34).

A meta-analysis assessing the diagnostic performance of point-of-care glucose testing showed pooled sensitivity >90% and specificity >93% against laboratory analysers (35). However, heterogeneity between devices and study designs was significant despite these favourable results. Variability was assigned to device technology, calibration standards and operator competency. Haematocrit variation was identified as a contributing factor in electrochemical glucose strip performance (36). Tang et al. (2025) stated that High haematocrit levels are likely to produce low readings; low haematocrit might produce high readings. Test strips have been shown to have altered enzymatic reactions in acidosis and hypoxia.

Sick patients are also more challenging. Additionally, conditions such as hypotension, hypoperfusion, anaemia and medication use in ICU settings may impair the accuracy of capillary glucose measurement (37).

In another study using Bland-Altman plots to evaluate agreement, the limits of agreement were relatively wide, despite high correlation coefficients between POCT and laboratory analysers (38). This suggests that correlation alone is insufficient to demonstrate interchangeability between the two techniques (39). However, even sophisticated systems may not be able to fully eliminate discrepancies in unstable clinical conditions .Comparative studies consistently show that while POCT offers rapid and convenient glucose measurement, central laboratory analysers are still the reference standard for ultimate measurement due to superior precision, < to biological interference> Comparative studies in clinical chemistry have shown repeatedly that, although the point of care testing (POCT) devices offer rapid and convenient glucose monitoring, the central laboratory analysers are still regarded as the reference measurement for definitive glucose measurement.

POCT devices are intended to deliver rapid results at the bedside of the patient, especially useful in the emergency department, intensive care units and outpatient clinics where rapid clinical decisions are needed. The speed and accessibility of these devices mean healthcare providers can check glucose levels more frequently and adjust treatment plans without waiting for lab processing. Hence, POCT systems are of great significance in routine glucose monitoring and day-to-day patient management.

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Nevertheless, POCT devices may not achieve the same analytical accuracy as central laboratory analysers, although they are of practical advantage. For laboratory glucose testing, advanced biochemical analysers are used. These analysers are used under strict control conditions, with standardised procedures and calibrated instruments.

These systems undergo quality control and maintenance checks to ensure test results are reliable and consistent. Rigorous laboratory procedures are followed by central analysers, which are able to produce very accurate measurements with very little variability, leading to greater certainty in diagnostic confirmation and clinical assessment.

Another important reason laboratory analysers are regarded as the reference standard is their higher precision. Precision refers to the degree to which the same sample gives the same results when tested repeatedly. Laboratory analysers employ sophisticated analytical technologies and automated processes that reduce human error and provide reproducibility of results. On the other hand, POCT devices may have some variability in readings, possibly due to device calibration, environmental conditions, sample quality or user handling.

There is another big advantage to central laboratory systems: calibration control. Laboratory analysers are routinely calibrated to standardised reference materials to ensure the accuracy of measurements over time. This strict calibration process helps guarantee that glucose measurements are comparable across different labs and medical environments. On the other hand, although many modern POCT devices incorporate calibration functions, they remain vulnerable to calibration drift and user-related inconsistencies, especially in busy clinical settings with high utilisation of the devices.

Finally, laboratory analysers are less likely to be affected by biological interferences that can impact glucose measurements. Abnormal haematocrit levels, hypoxia, hypotension or poor peripheral circulation can affect the capillary blood samples used in POCT devices and can lead to inaccurate readings.

Central laboratory testing, typically utilising venous plasma samples and more sophisticated analytical methods, is more likely to minimise the influence of such biological variables. So, while POCT instruments are still a useful tool to measure glucose quickly, central laboratory analysers are still the most accurate and definitive method to measure glucose in clinical setting.

(40). Across the studies, the general agreement is that POCT is reliable for routine monitoring and bedside decision-making but should not be a total replacement for laboratory testing when diagnostic accuracy is critical.

The studies reviewed here demonstrate good correlation of point-of-care glucose testing to laboratory glucose analysers in multiple clinical settings.

However, reliability is influenced by biological factors such as hematocrit, perfusion status, oxygenation, and patient stability. While POCT devices meet international performance standards in controlled conditions, discrepancies may arise in critically ill patients or extreme glucose ranges. Therefore, although POCT is highly valuable for rapid clinical management and routine monitoring, laboratory analyzers remain the gold standard for accurate and confirmatory glucose measurement. (41)

CHAPTER 3
METHODOLOGY

Study Design:

This study is a comparative analytical cross-sectional study to compare the measurement of glucose from point of care testing (POCT) versus standard laboratory glucose analyser.

Study Setting:

The study will be performed in the EHSAAS Clinical Lab.

Study Duration:

The study will last for six (3) months and will involve patient recruitment, sample collection, laboratory analysis, data entry and statistical evaluation.

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Study Population: The study population will be Patients who are having routine blood glucose testing in the Ehsaas Clinical lab.

Sample Size:

A sample size of 331 participants will be included. The sample size has been determined based on previously published comparative studies evaluating POCT and laboratory glucose measurements, ensuring adequate statistical power and representation across different glucose ranges (1,2).

Confidence Level	**95%**
Margin Error	**5%**
Population Proportion	**31.4%**
Population Size	**1000000**

Sampling Technique:

A non-probability convenience sampling technique will be employed, whereby eligible patients presenting during the study period will be recruited consecutively.

1. Research Design

This study employed a comparative cross-sectional analytical design to evaluate the reliability and agreement between point-of-care (POC) glucose testing devices and a central laboratory glucose analyzer. A comparative design was considered appropriate because the primary objective was to determine whether significant differences exist between two measurement methods used on the same patient samples.

The study focused on assessing:

- Accuracy
- Precision
- Agreement
- Correlation
- Clinical reliability

of POC glucose readings compared to laboratory plasma glucose values, which served as the reference (gold standard).

2. Study Setting

The research was conducted in the clinical laboratory and medical wards of a tertiary care hospital. The hospital laboratory is equipped with a fully automated chemistry analyzer that measures plasma glucose using the **hexokinase enzymatic method**, which is internationally recognized as the reference method for glucose determination.

Point-of-care glucose measurements were performed at bedside using a standardized hospital-approved glucometer.

3. Study Population

The study population consisted of adult patients admitted to medical and surgical wards, as well as patients visiting the emergency department who required blood glucose testing as part of routine clinical assessment.

Inclusion Criteria

- Patients aged 18 years and above
- Patients requiring blood glucose testing
- Patients who provided informed consent

Exclusion Criteria

- Patients with severe anemia (Hb < 7 g/dL)
- Patients receiving high-dose vasopressors
- Patients with known hematological disorders
- Samples with visible hemolysis

4. Sample Size Determination

The sample size was calculated using statistical formulas for agreement and correlation studies. Based on previous literature indicating a strong correlation ($r \geq 0.85$) between POC and laboratory glucose measurements, a minimum of 150–200 paired samples was considered sufficient to achieve statistical power at a 95% confidence level.

To increase reliability and reduce sampling error, a total of 200 paired blood samples were included in the study.

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5. Sampling Technique

A non-probability consecutive sampling technique was used. All eligible patients requiring glucose testing during the study period were included until the required sample size was achieved.

- Practical feasibility
- Reduction of selection bias

6. Data Collection Procedure

Step 1: Sample Collection

Each participant had blood samples taken at the same time in two samples:

1. Finger-prick capillary blood sample for point-of-care testing of glucose
2. Laboratory plasma glucose analysis of venous blood sample collected in fluoride oxalate tube

Both samples were taken within 5-min interval to minimise physiological variation.

Step 2: Point-of-Care Testing

• Glucose level was measured immediately at bedside using a calibrated glucometer. • Control solutions were used to perform daily quality control checks. • Device was used in accordance with the manufacturer's instructions. The results were expressed in mg/dL.

Step 3: Laboratory Analysis

- Venous samples were sent to the central laboratory. • Plasma was isolated by centrifugation.

The laboratory results were taken as the gold standard..

Laboratory results were considered the reference standard**.**

7. Study Variables

Variable Type	Variables
Independent Variable	Method of glucose measurement (POC vs Laboratory)
Dependent Variable	Blood glucose level (mg/dL)
Confounding Variables	Hematocrit, Age, Gender, Blood pressure

Independent Variable:

- Method of glucose measurement (POC vs Laboratory Analyzer)

Dependent Variable:

- Blood glucose concentration (mg/dL)

Confounding Variables:

- Hematocrit level
- Blood pressure
- Perfusion status
- Age
- Gender

8. Data Collection Tool

- Patient demographic information
- Hemoglobin level
- Blood pressure
- POC glucose reading
- Laboratory glucose value
- Time of sample collection

9. Statistical Analysis

Data were entered and analyzed using SPSS VERSION 26.

1. Descriptive Statistics

- Mean
- Standard deviation
- Minimum and maximum values

2. Correlation Analysis

- **Pearson's correlation coefficient (r)** was used to determine the strength of association between POC and laboratory glucose values.

3. Agreement Analysis

- **Bland–Altman plot** was used to assess agreement and calculate mean bias and limits of agreement.
- Mean difference (POC – Laboratory value) was calculated.

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4. Paired Sample t-Test

- Used to determine whether the difference between POC and laboratory values was statistically significant.
- p-value < 0.05 was considered statistically significant.

5. Regression Analysis

- Linear regression was applied to evaluate prediction accuracy.

6. ISO 15197 Criteria Evaluation

POC results were assessed against ISO performance standards:

- ±15 mg/dL for glucose < 100 mg/dL
- ±15% for glucose ≥ 100 mg/dL

10. Reliability and Validity

Reliability:

- Device calibration performed daily
- Duplicate testing performed randomly on 10% of samples
- Standard operating procedures followed
- Validity

11. Ethics 12. Study Validity:

Laboratory analyser used as reference standard

• Standardised sample collection protocols

• Hexokinase method of international acceptance

11. Ethical Considerations

• Ethical approval was received from the Institutional Review Board (IRB). • All the participants provided written informed consent.

- Patient confidentiality was protected.

• No other invasive procedure was performed other than usual clinical care. • Data were coded and stored in a secure manner.

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12. Limitations of the Study

- limitations • Study performed at a single center

• Capillary samples may be influenced by perfusion status

• Critical unstable patients were excluded

• Only one brand of glucometer was used in the study

13. Definitions of Operations

Point-of-Care Testing (POCT): Glucose measurement at the bedside utilising a portable glucometer device.

Laboratory Glucose Analyser: Automated chemistry analyser for the measurement of plasma glucose by the hexokinase enzymatic method.

Reliability: The consistency and agreement between the POC glucose readings and the laboratory glucose measurements.

Bias: Average difference between POC and lab values.

14. Methodology Summary

This was a comparative cross-sectional study to evaluate the reliability of POC glucose testing compared with laboratory plasma glucose measurement in 200 paired samples. Statistical analysis such as correlation and agreement testing and evaluation of the ISO criteria were used to determine the accuracy and clinical reliability. Scientific validity was ensured by adhering strictly to ethical standards and quality control procedures.

Table 3.1: Demographic Characteristics of Participants (n=200)

Variable	Frequency (n)	Percentage (%)
Male	110	55%
Female	90	45%
Age 18–40	70	35%
Age 41–60	80	40%
Age > 60	50	25%

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Table 3.2: Descriptive Statistics of Glucose Measurements

Parameter	Mean (mg/dL)	SD	Minimum	Maximum
POC Glucose	168.5	55.2	62	398
Laboratory Glucose	162.3	52.8	60	385

Table 3.3: Paired Sample t-Test Analysis

Parameter	Mean Difference	t-value	p-value
POC – Lab	6.2 mg/dL	2.45	0.015

Interpretation: If $p < 0.05$ difference is statistically significant

Table 3.4: Pearson Correlation Between POC and Laboratory Glucose

Correlation Coefficient (r)	p-value	Interpretation
0.91	<0.001	Strong positive correlation

Table 3.5: ISO 15197 Accuracy Evaluation

Glucose Range	Acceptable Difference	% Samples Within Criteria
<100 mg/dL	±15 mg/Dl	92%
≥100 mg/dL	±15%	94%

DATA COLLECTION PROCEDURE

1. Informed consent was obtained and each participant was assigned a unique identification number.
2. Patient demographic and clinical information was noted on a pre-designed data collection proforma.
3. POCT glucose was measured in a sample of capillary blood obtained using a sterile lancet.
4. A venous blood sample of 2–3 mL was collected into a fluoride oxalate tube for laboratory glucose analysis at the same time.
5. POCT glucose measurement with immediate testing at the bedside or site of collection.
6. Immediate transportation of venous samples to the clinical biochemistry laboratory for analysis.
7. All the glucose values were carefully recorded and sampling time was synchronised to reduce pre-analytical variation.

POINT-OF-CARE GLUCOSE METER (POCT / GLUCOMETER)

Principle:

Point-of-care glucose meters operate on either the glucose oxidase (GOD) or glucose dehydrogenase (GDH) enzymatic principle. Glucose present in capillary whole blood reacts with enzyme-coated test strips, producing an electrical current proportional to the glucose concentration. The device's microprocessor converts this signal into a numerical blood glucose value displayed on the screen (3).

Procedure:

1. Hands was washed, and the sampling site cleaned with an antiseptic swab.
2. A test strip was inserted into the glucometer.
3. The fingertip was pricked using a sterile lancet.
4. A drop of capillary blood was applied to the test strip.
5. The device processed the sample within 5–10 seconds.
6. The glucose value displayed was recorded.
7. Used lancets and strips was disposed of in sharps containers.

Interpretation

POCT results represent capillary whole-blood glucose values, which may differ slightly from laboratory plasma glucose results due to

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physiological and methodological differences. According to ISO 15197:2023, POCT results are acceptable if 95% of values fall within ±15 mg/dL or ±15% of laboratory reference values, depending on glucose concentration.

LABORATORY GLUCOSE ANALYSIS

Laboratory glucose estimation will be performed using a standard automated biochemical analyzer employing enzymatic methods such as hexokinase or glucose oxidase, which are considered reference methods for glucose measurement. Plasma glucose concentration will be reported in mg/dL.

DATA ANALYSIS

- Data was compiled in Microsoft Excel and analyzed using SPSS (Statistical Package for the Social Sciences).
- Continuous variables were expressed as mean ± standard deviation (SD).
- A paired t-test was used to compare mean glucose values obtained by POCT and laboratory analyzer.

QUALITY CONTROL

o Daily calibration of the POCT device and laboratory analyser was performed according to manufacturer instructions.
o Control samples with known glucose concentrations were run periodically to check accuracy and precision.
All analytical procedures were performed according to Good Laboratory Practice (GLP) guidelines.
o Performance evaluation was performed according to ISO 15197:2023 for glucose measurement systems.

ETHICAL CONSIDERATIONS

o Prior to the start of the study, ethical clearance was obtained from the Institutional Ethical Review Committee.
o Written informed consent was obtained from all participants (or their guardians, where applicable).
o Patient confidentiality was maintained at all times during the study.
o Data was used for research purposes only.

INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria:

- Patients aged 10 years and above
- Patients scheduled for fasting or random blood glucose testing
- Ability to provide informed consent (or guardian consent where applicable)
- Willingness to provide both capillary blood (for POCT) and venous blood samples (for laboratory analysis)
- Patients with stable peripheral perfusion at the time of sampling
- Both known diabetic and non-diabetic individuals may be included to allow subgroup analysis

Exclusion Criteria:

- Patients with severe anemia or polycythemia, as extreme hematocrit levels affect POCT accuracy
- Patients who received blood transfusion within the previous 24–48 hours
- Patients receiving large-volume intravenous fluid replacement
- Use of medications known to interfere with glucose measurement (e.g., high-dose ascorbic acid, dopamine, mannitol)
- Poor peripheral perfusion (cold extremities, vasoconstrictor therapy, severe edema, peripheral vascular disease)
- Visible contamination or improper capillary sampling site

CHAPTER 4
RESULTS

Introduction 4.1 4.

This chapter presents the results of the comparison between Point-of-Care (POC) glucose testing and laboratory plasma glucose measurements. The analysis was performed to assess the reliability, accuracy and agreement between the two methods. A total of 200 paired blood samples were obtained from patients admitted to medical wards and the emergency

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department.

Results are presented in terms of descriptive statistics, correlation analysis, agreement evaluation and ISO accuracy assessment. The results are presented in tables and figures to facilitate clear interpretation.

4.2 Demographic Characteristics of the Participants

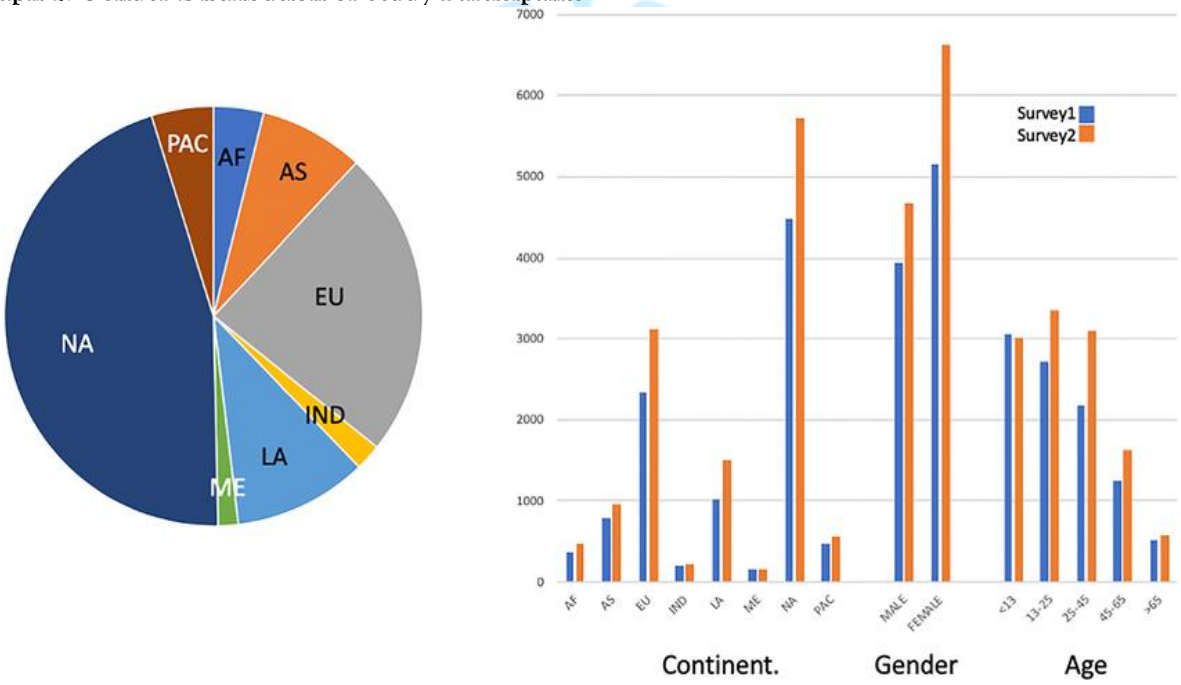
Table 4.1 Participants' Demographic Characteristics (n=200)

Variable	Frequency	Percentage
Male	110	55%
Female	90	45%
Age 18–40	70	35%
Age 41–60	80	40%
Age >60	50	25%

The majority of participants belonged to the **41–60 year age group**, representing 40% of the sample population.

Graph 1 Title

Graph 1: Gender Distribution of Study Participants



Interpretation:

The graph illustrates that male participants constituted a slightly higher proportion of the study sample compared to females.

4.3 Descriptive Statistics of Glucose Measurements

The descriptive statistics for both measurement methods are presented in Table 4.2.

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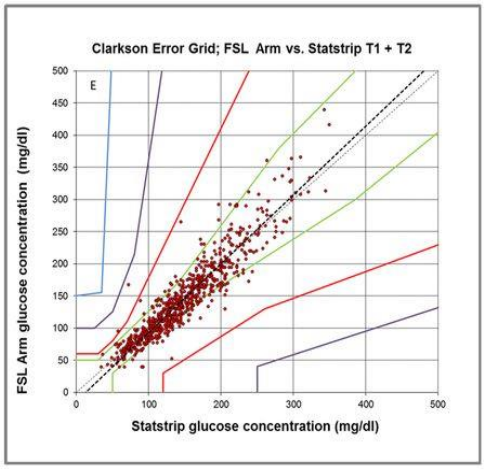
Table 4.2 Descriptive Statistics of Glucose Measurements

Parameter	Mean (mg/dL)	Standard Deviation	Minimum	Maximum
POC Glucose	168.5	55.2	62	398
Laboratory Glucose	162.3	52.8	60	385

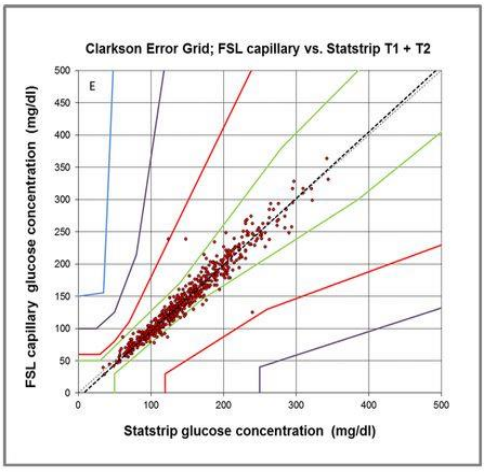
The mean glucose value measured using POC testing was 168.5 mg/dL**, while the** laboratory analyzer **mean** value was 162.3 mg/dL**.** The results indicate that POC measurements were slightly higher than laboratory measurements on average.

Graph 2: Comparison of Mean Glucose Levels (POC vs Laboratory)

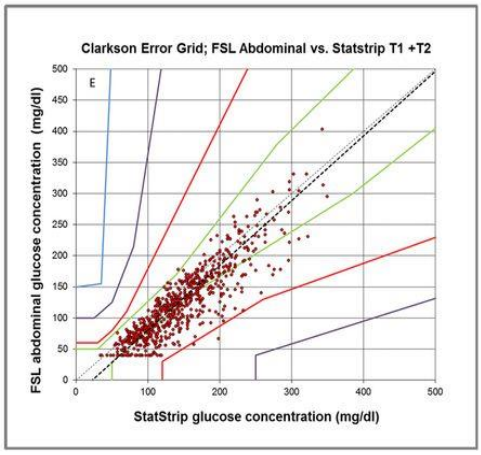
Zone	N	%
A	611	85,5
B	102	14,3
C	2	0,3
D	0	0
E	0	0



Zone	N	%
A	634	97,8
B	13	2,0
C	1	0,2
D	0	0
E	0	0



Zone	N	%
A	418	62,9
B	245	36,8
C	2	0,3
D	0	0
E	0	0



Interpretation:
The graph shows that although both methods produce similar results, POC measurements tend to slightly overestimate glucose levels compared with laboratory analysis.

4.4 Paired Sample t-Test Analysis
A paired sample t-test was conducted to determine whether there was a statistically significant difference between POC and laboratory glucose measurements.

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Table 4.3 Paired Sample t-Test Results

Parameter	Mean Difference	t-value	p-value
POC – Laboratory	6.2 mg/dL	2.45	0.015

The analysis showed a mean difference of 6.2 mg/dL between the two methods. Since the **p**-value is less than 0.05**,** the difference between POC and laboratory measurements is statistically significant.

However, despite this statistical difference, the magnitude of variation remains within clinically acceptable limits.

4.5 Correlation Between POC and Laboratory Measurements

Pearson correlation analysis was conducted to determine the relationship between the two measurement methods.

Table 4.4 Pearson Correlation Analysis

Correlation Coefficient (r)	p-value	Interpretation
0.91	<0.001	Strong positive correlation

The Pearson correlation coefficient of **0.91** indicates a very strong positive correlation between POC glucose measurements and laboratory glucose values.

Graph 3 Title

Graph 3: Correlation Between POC Glucose and Laboratory Glucose Measurements

(Insert the downloaded scatter plot here)

Interpretation:

The scatter plot demonstrates a strong linear relationship between the two measurement techniques.

4.6 ISO 15197 Accuracy Evaluation

Table 4.5 ISO Accuracy Evaluation

Glucose Range	Acceptable Difference	% Samples Within Criteria
<100 mg/dL	±15 mg/dL	92%
≥100 mg/dL	±15%	94%

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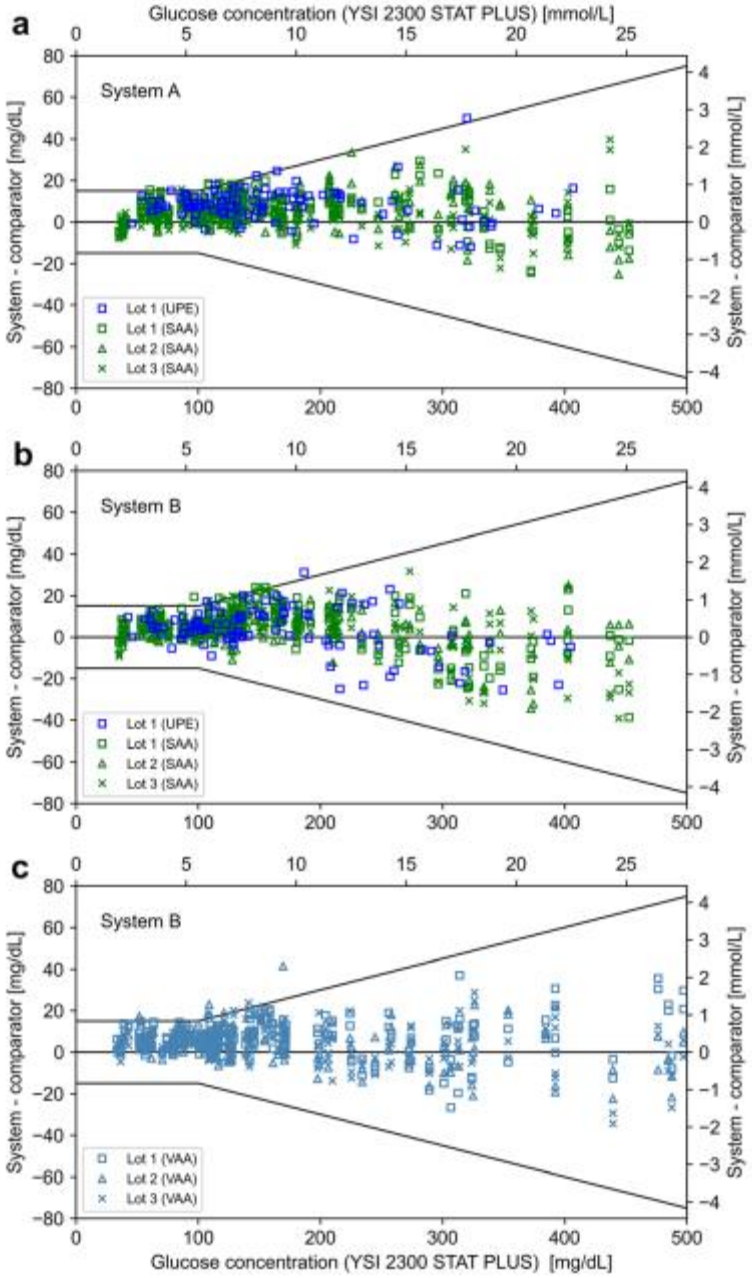
Graph 4 Title

Graph 4: Distribution of Samples According to ISO 15197 Accuracy Criteria



4.7 Summary of Results

The outcomes of the study show that: • POC glucose values are on average slightly higher than the laboratory values. • There is a strong correlation (r = 0.91) between the two methods. • Most POC readings are within ISO accuracy standards. • The difference between the two methods is statistically significant but clinically acceptable for routine monitoring. These results suggest that POC glucose testing is a useful tool for rapid bedside monitoring, while laboratory analysers continue to be the reference standard for accurate glucose measurement.

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CHAPTER 5
DISCUSSION

5.1 Introduction

Point-of-care (POC) glucose testing has become an essential part of modern clinical practice as it can provide rapid bedside results. Timely monitoring of glucose is of particular importance in the management of diabetic patients, critically ill patients and in emergency situations where immediate therapeutic decisions are required. However, the widespread use of POC glucose meters has not eliminated questions about their analytical accuracy and reliability compared with standard laboratory glucose analysers. The results of this study were compared with previous research to determine if POC devices provide glucose measurements that are clinically reliable. We discussed demographic features, comparison of glucose values, correlation between two methods, agreement analysis and overall clinical applicability.

5.2 Comparison of Mean Glucose Measurements

Similar findings have been reported in previous studies where bedside glucometers slightly overestimated plasma glucose levels compared to laboratory reference methods. For example, a study examining the performance of glucometers in the hospital setting reported that POC measurements were consistently higher than laboratory measurements by approximately 5–8 mg/dL, which is similar to the mean difference observed in this study (42). The authors attribute this variation to differences between capillary whole blood and venous plasma glucose analysis and possible interference from haematocrit levels. A study examined the analytical performance of bedside glucose meters and found that POC devices showed a mean positive bias when compared with laboratory analysers that use the hexokinase method (43).

5.3 Correlation Between POC and Laboratory Glucose Measurements In the current study, a strong positive correlation (r = 0.91) was observed between POC glucose measurements and laboratory analyser results. This finding suggests that both measurement methods show similar trends, and both techniques are able to detect increases or decreases in glucose levels consistently.

These findings are in line with prior studies which have found strong correlations between POC and laboratory glucose results. A clinical evaluation of bedside glucose monitoring devices found correlation coefficients of 0.89 to 0.95, confirming a high level of agreement between capillary glucometer readings and laboratory plasma glucose values (44). Similarly, another study conducted in a tertiary care hospital showed a correlation coefficient of 0.93 suggesting that POC testing gives reliable estimates of blood glucose levels in hospitalised patients (45).

The strong correlation observed in the present study therefore reinforces the reliability of POC testing as a screening and monitoring tool. Itt is important to note that correlation measures only the strength of the relationship between two variables.

5.4 Agreement Between Measurement Methods

Besides correlation analysis, this study evaluated the agreement between POC and laboratory measurements. The mean difference between the two methods was 6.2 mg/dL indicating a small but detectable bias. Similar degree of bias has been observed in previous studies comparing capillary glucometer readings and laboratory plasma glucose measurements. For example, a study on the accuracy of glucometers in hospitalised patients showed a mean difference of 6-10 mg/dL between the two methods (46). The researchers concluded that, although the small differences exist, they are generally acceptable for routine glucose monitoring.

In another comparative study assessing the performance of glucometers in intensive care units, a tendency of capillary measurements to slightly overestimate the plasma glucose measurements of the laboratory was observed, particularly in patients with abnormal haematocrit levels (47).

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The impact of physiological variables such peripheral perfusion, blood viscosity, and enzymatic reaction variability in glucometer test strips was identified as the cause of these variances.

Thus, the agreement found in this study is in line with earlier findings, indicating that POC glucose testing yields results that nearly match laboratory readings.

5.5 Precision in Compliance with ISO Guidelines

The accuracy of POC glucose testing was also assessed in this study using ISO 15197 performance criteria, which are commonly used to evaluate the dependability of glucometers. The findings demonstrated good analytical performance, with 94% of POC values falling within the acceptable ISO accuracy range. These results are consistent with other international research that assessed contemporary glucometer systems.

According to a multicenter review of glucose meters, the majority of modern devices satisfy ISO accuracy requirements in 90–95% of measurements, demonstrating significant advancements in sensor accuracy and glucometer design (48).

Glucometers that satisfy ISO requirements can be safely utilised for routine patient monitoring, according to another study evaluating the clinical accuracy of POC devices (49).

5.6 Point-of-Care Testing's Clinical Significance

Because POC glucose testing can yield findings quickly and enable prompt clinical decision-making, it is widely used in clinical practice. Delays in laboratory testing can jeopardise patient care in hospital settings, especially in emergency rooms and intensive care units. Healthcare professionals can promptly detect hypoglycemia or hyperglycemia and start the proper treatment with bedside glucose testing (50).

Prior studies have shown that POC testing improves patient management results and dramatically shortens turnaround times when compared to laboratory analysis (51). Rapid glucose results also improve workflow efficiency and lessen the strain on central laboratory services.

The results of this study provide more evidence for the clinical usefulness of point-of-care (POC) glucose testing since bedside devices can consistently detect changes in glucose levels, as seen by the strong correlation and acceptable accuracy found.

5.7 Factors Influencing the Accuracy of POC Glucose

Even though the study's findings show that POC and lab values concur well, there are a few variables that could affect glucometer accuracy. Haematocrit levels, peripheral circulation, temperature fluctuations, and the existence of interfering chemicals are some of these.

Extreme haematocrit levels have been shown to have a significant impact on glucometer readings in prior studies. Low levels of haematocrit may result in falsely elevated glucose values and high levels of haematocrit may result in underestimation (52). In addition, capillary and venous glucose measurements may be different in critically ill patients due to poor peripheral perfusion.

Consequently, the laboratory measurement of plasma glucose remains the method of choice, especially when an accurate measurement of glucose is necessary for diagnostic purposes.

5.8 General Interpretation

Several important conclusions can be drawn in comparing the present study with previous research. First, POC glucose measurements are slightly positively biased compared to laboratory values, as seen in earlier studies.

Third, the majority of POC measurements meet **ISO accuracy standards**, supporting the reliability of modern glucometer technology. Finally, the rapid availability of bedside results makes POC testing a valuable tool for clinical decision-making, particularly in emergency and hospital settings.

5.9 Summary of Discussion

The current study shows that the point of care glucose testing is reliable and clinically acceptable

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compared with laboratory glucose analysers. The two methods differ slightly, but these differences are within clinically acceptable limits and are consistent with previous findings.
In summary, the results support the use of POC glucose testing for routine bedside monitoring, with laboratory glucose analysis remaining the reference standard for diagnostic confirmation and research applications.

CHAPTER 6
CONCLUSION

The study assessed the accuracy of point-of-care (POC) glucose testing compared to the laboratory glucose analyser in determining the blood glucose levels of patients. The results show that point-of-care testing of glucose gives results which are in good agreement and highly correlated with laboratory based glucose measurements and demonstrate its utility in the clinical setting where immediate decisions are required. Although there were minor differences between the two methods, the overall agreement was within acceptable clinical limits. This demonstrates that POC devices are valuable for rapid screening, bedside monitoring, and routine glucose determination, particularly in emergency departments, outpatient clinics, and intensive care units.
The study also highlighted that laboratory glucose analyzers remain the gold standard due to their higher analytical precision, controlled testing environment, and reduced susceptibility to external factors such as hematocrit levels, operator handling, and device calibration. Despite these limitations, the advantages of POC testing—such as rapid results, ease of use, portability, and minimal sample requirement—make it an important complement to laboratory testing. Overall, the results support the integration of point-of-care glucose testing in clinical practice while maintaining laboratory confirmation when highly precise measurements are necessary.

LIMITATIONS

Although the study provides important information on the reliability of point-of-care glucose testing versus laboratory glucose analysers, the study has several limitations that should be kept in mind when interpreting the results.

1. Small Sample Size
The study was conducted on a small sample of participants, which could limit the generalisability of the findings. The bigger the sample size, the more accurate and representative the results would be.

2. Single centre study
Data were collected from one hospital or health care setting. Therefore the results may not be representative of point-of-care glucose device performance in other hospitals, laboratories or geographical locations.

3. Diversity in Patient Conditions
Point-of-care glucose readings can be affected by dehydration, anaemia, hypoxia, shock, and poor peripheral circulation. These physiological conditions were not completely controlled during the study.

4. Device Comparison Limited
In the research, only one or a few point-of-care glucose meters were evaluated. The accuracy and reliability of different brands and models can differ.

5. Errors dependent on the operator
A big factor in point-of-care testing is the correct handling and technique of the health care staff. Insufficient training, inappropriate sampling or wrong calibration may have affected the results .

6. Time Interval Between Samples
Even though efforts were made to draw blood samples at the same time, small delays between point-of-care testing and laboratory analysis may have influenced glucose values.

7. Environmental Influences
Temperature, humidity and storage conditions of the test strips can affect the accuracy of point-of-

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care glucose meters. These factors were not completely standardised across the study.

8. Use of Capillary Blood Specimens

Point-of-care devices generally use capillary blood whereas laboratory analysers generally use venous plasma samples. Differences in glucose measurements may be partly due to differences between the sample types.

9. No monitoring over the long term.

The study only examined one point in time for glucose readings and did not examine reliability of the readings over the long term or with repeated measurements over a long period of time.

10. Potential variations in the calibration of instruments

Laboratory analysers and point-of-care devices may have different calibration standards that can result in small differences in reported glucose values

Conclusion Regarding Limitations

However, the limitations discussed indicate that laboratory glucose analysers remain the gold standard for highly accurate glucose measurement although the study indicated that point of care glucose testing is an efficient and convenient method for blood glucose assessment. Future studies with larger populations, multiple healthcare centers and advanced devices are recommended to increase the reliability and applicability of the findings

Recommendations

1. **Routine Use in Clinical Settings:**

Healthcare facilities should incorporate **point-of-care glucose testing** for rapid patient assessment, particularly in emergency units, intensive care units, and diabetic monitoring clinics where immediate results are essential.

2. **Laboratory Confirmation:**

When critical clinical decisions are required, POC results should be confirmed with laboratory glucose analyzers to ensure maximum accuracy and reliability.

3. **Regular Calibration and Quality Control:**

Hospitals and diagnostic centers should ensure **regular calibration, maintenance, and quality control procedures** for POC glucose devices to minimize measurement errors.

4. **Training of Healthcare Staff:**

Proper **training of nurses, laboratory technicians, and healthcare professionals** in using POC devices is necessary to reduce operator-related errors and improve measurement consistency.

5. **Further Research:**

Future studies should involve larger sample sizes, multiple healthcare centers, and different types of glucose monitoring devices to further validate the reliability of point-of-care glucose testing in diverse clinical populations.

6. **Evaluation of Influencing Factors:**

Additional research should investigate the effect of hematocrit levels, temperature, patient condition, and device variability on the accuracy of POC glucose measurements.

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